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17 August 1960

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Attention: [redacted] 25X1

Dear Sir:

Reference: Monthly Report
Project 64.15

Project 64.15 consists of Phase I, 5 groups of bandpass amplifiers and Phase II, a study and development of a 500 to 1000 mcs transistor amplifier.

The amplifier frequency ranges are:

Type 1	50-90 mcs	- 5 ea
Type 2	100-150 mcs	- 5 ea
Type 3	50-250 mcs	- 10 ea
Type 4	250-500 mcs	- 10 ea
Type 5	600-700 mcs	- 5 ea

Prototypes of these amplifiers have been built with characteristics similar to those stated in Proposal P-1150.

The individual amplifiers will be standardized to fit in a package approximately 1 x 1 x $2\frac{1}{2}$ inch modules, except for Type 5, 600-700 mcs. Each module will contain four transistor stages. For field repair modules may be replaced. For multi-module amplifiers, single inoperative stages may be bypassed for continued operation at reduced gain. Amplifier types 1, 2, and 3 contain one module, Type 4 contains two modules and Type 5 contains approximately four modules. A variety of tentative packages have been fabricated and drawings have been prepared for the preliminary model of the selected package type.

The chassis will probably be silver plated bronze with aluminum or silver plated brass covers.

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Power connectors have been specified by the contractor. The batteries to be used with the amplifiers will not be supplied but will be specified as required, depending on the results of environmental tests.

A design figure of merit may be defined as:

$$DFM = \frac{G \times f_c^2 \times Po}{P_{in} \times V \times NF \times S}$$

where

G	=	Power gain
f_c	=	Upper cutoff frequency
Po	=	Available signal power
P_{in}	=	Power supply input
V	=	Amplifier volume
NF	=	Noise Figure
S	=	Temperature stability

For specialized applications each of the factors are weighted. However, for a given application the design figure of merit provides a useful comparison for the different amplifiers.

Accordingly, these amplifiers will be designed for optimum DFM.

The gain G, and upper cutoff frequency f_c, of each amplifier type is fixed by application requirements. Although these are bandpass amplifiers for one or two octave coverage the lower frequency limit may be neglected. The upper cutoff frequency is squared for transistor amplifiers and a linear function for vacuum tube amplifiers.

The power output Po is constant and is of little importance for small signal pre-amplifiers.

The power input and physical size of these amplifiers will be kept as small as possible.

In the design of broadband transistor amplifiers it is possible to eliminate some circuit components and to operate the transistors more conservatively resulting in more stages, but reduced overall size and power requirements.

Noise figure must be kept as small as possible if an improvement in system tangential sensitivity is to be realized.

Stability factor, S, will be small to reduce the effects of supply voltage variations and to permit operation over a wide range of temperatures.

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Section II of P-1150, the study and development of a 500 to 1000 mc amplifier has begun with the measurement of high frequency parameters of transistor types 2N700 and 2N502. Other high frequency transistors have been ordered and will not be available before 6 to 8 weeks. The usual data as supplied by manufacturers is very sketchy for high frequency parameters. Deviations from published data of greater than 30% have been observed. For performance to 1000 mcs, high frequency parameters must be measured.

Very truly yours,

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Project Engineer

LR:gsj

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